**Testimony of**

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Thank you, Mr. Chairman and members of the Committee. I appreciate the opportunity to bring you up to date on the Department of Energy's response to allegations of current and historical environment, safety and health (ES&H) problems at the Paducah Gaseous Diffusion Plant in Paducah, Kentucky, and the other two gaseous diffusion plants (GDPs) in Piketon, Ohio and Oak Ridge, Tennessee.

When these concerns were brought to his attention last summer, Secretary Richardson immediately ordered complete and independent investigations. He further committed to determine if workers were made ill because of inadequate worker protections, and that if they were, to seek to provide them with fair compensation. To help find the answers to these questions, the Secretary directed my office to expand the ongoing worker medical surveillance program at the three sites, conduct a worker exposure assessment project to help determine actual worker doses to radiation, and complete a so-called 'mass flow' assessment to help us understand how much recycled uranium was generated over 47 years and where it all went. My testimony today will describe these activities and our progress to date in meeting the Secretary's commitments.

**Historical Background**

The first full production-size gaseous diffusion plant was built on the K-25 site in Oak Ridge, Tennessee, as part of the original Manhattan Project. The gaseous diffusion process at K-25 started operation at the end of World War II and continued to operate until it was closed in 1985. Lessons learned from operating the process at K-25 were factored into the design of both the Paducah and Portsmouth plants, which were built during the early 1950s.

Although the original mission of the enrichment complex was to produce nuclear weapons-grade enriched uranium, in the 1960s the plants began to produce low enriched uranium for commercial nuclear power plants. The efficiency and capacity of the three gaseous diffusion plants was increased to fulfill the demand for new commercial nuclear power plants, and increasing demand for enriched uranium for the weapons program. A $1.4 billion cascade improvement plan was initiated in the early 1970s and completed in the 1980s. The program increased the gaseous diffusion capacity of the plants by about 60% and at a substantially lower cost than construction of new facilities.

**How the Gaseous Diffusion Plants Worked**

The Paducah and Portsmouth plants have been in continuous operation since 1952 and 1954 respectively, producing enriched uranium for both commercial and military applications. The plants were constructed and operated in series -- Paducah produced enrichments from 0.7% (natural uranium) up to about 2% (later upgraded to 2.75%). The output of Paducah was sent to Portsmouth for further enrichments. Portsmouth produced fully enriched uranium (>95% $U^{235}$) for weapons, as well as slightly enriched uranium for use in commercial nuclear

power plants. The feed streams at K-25, Portsmouth and Paducah included recycled uranium that was recovered from spent fuel from various sources, which introduced transuranics and other isotopes into process equipment.

Various other operations were conducted at the three GDPs including: smelting and reduction of uranium hexafluoride ($UF_6$) and uranium tetrafluoride ($UF_4$ ) back to uranium metal; production of nickel and aluminum ingots; classified defense projects that involved the recovery of metals from weapon components; and operation of chemical plating laboratories.

The fuel process begins with the mining of ore that is converted to uranium oxide ($UO^3$) and sent to the gaseous diffusion plants. The $UO_3$ is converted to $UF_4$ (also known as green salt) through a hydrogen/fluorination process. Further hydro-fluorination produces $UF_6$ . The gaseous diffusion process employs a series of compressors and converters to enrich the $U^{235}$ isotope of the process gas $UF_6$ . The building block of the process is a single compressor and converter, know as a stage. Several stages are put together to form cells, and then numerous cells are connected into what is known as the 'cascade.' Several hundred stages of successive enrichment are necessary to enrich the uranium to a commercially usable product. The large amount of equipment at the plants (motors, compressors, converters, control valves, instrumentation, piping and support systems) required substantial maintenance, repair, disassembly, decontamination, and cleaning of plant materials. The output of the process is enriched $UF_6$ that was transported offsite in cylinders, and $UF_6$ tail gas that is solidified and stored onsite in cylinders.

Hazards to workers were present by exposure to radiation in several forms, including:

- Uranium – Naturally occurs in earth, mined for commercial purposes. Contains several isotopes and when enriched in the $U^{235}$ isotope, is used for nuclear reactor fuel.

- Transuranics – A series of elements beyond uranium in atomic number. Transuranics were introduced into the GDP cascades when spent reactor fuel was reprocessed and uranium was extracted and recycled. Isotopes of concern include neptunium-237, which concentrates in the bones and liver, and plutonium-239 which concentrates in the bones. Both isotopes have very long radioactive half-lives.

- Fission Products – A series of elements created when $U^{235}$ (or another fissionable radionuclide) is split by neutron(s) in a nuclear reaction. Many fission fragments (other elements) are created. The significant elements important to health from recycling of spent fuel are technetium-99, which could pose a radiation hazard to the lungs and thyroid, and strontium-90, which concentrates in the bones.

In addition to radiation hazards, workers were likely exposed to a number of other hazardous materials, depending on their work assignments, including:

- Trichloroethylene (TCE) – TCE is colorless liquid with a chloroform odor extensively used as an industrial degreaser. It is an irritant to the respiratory tract and skin and concentrates in the respiratory system, heart, liver, kidneys, central nervous system and skin.

- Fluorine - Nearly colorless, yellowish gas that is a very strong oxidizer and burns all tissues and vegetation on contact. When combined with water, it forms hydrofluoric acid and reacts strongly with most substances, including organics, metal and glass.

- Chlorine – Yellow gases that form strong acids when exposed to water or moist air. Causes skin irritation and burns, eye irritation, and affects the mucous membranes and respiratory system.

- Chlorodiphenyl or Polychorinated Biphenyl (PCB) – PCBs are an older additive generally used in oil and gasket material to make them more flame retardant. It had been extensively used in ventilation system gaskets and transformer cooling oils at all GDPs. PCBs concentrate in the skin, eyes and liver.

- Mercury – A silver colored shiny liquid at room temperature. Used in control switches and control valves at the GDPs. Mercury can affect motor responses and the central nervous system.

- Uranium hexafluoride ($UF^6$) - Used to enrich uranium. Reacts with moisture to form hydrofluoric acid and uranyl fluoride.

- Fungicides – Used in cooling water systems for cooling towers as wood preservatives and to prevent mold and fungus growth in those systems.

- Arsenic/Cyanide – By-product of the plating process used at the GDPs, affect the central nervous system.

- Asbestos - Used in insulation and other industrial applications. Its fibers can cause asbestosis and mesothelioma, a deadly cancer affecting the pleura, or lining, of the lungs.

- Acids (nitric, sulfuric, hydrofluoric, etc) – Clear, colorless liquids that can cause skin irritation and burns and affect the mucous membranes and respiratory system.

- Beryllium - A metal that, if inhaled, can cause serious, and possibly fatal, lung disease, called Chronic Beryllium Disease.

Finally, workers at the three GDPs were also exposed to physical hazards, such as noise, and other standard industrial hazards.

**Status of Oversight Investigations**

As the Committee knows, our independent Oversight office has completed its comprehensive review of Paducah and submitted a final report last month, which is a matter of public record. We expect to complete our work at the Portsmouth plant in late May, and have conducted a scoping visit this month to begin our Oak Ridge review. We expect the Oak Ridge review to be completed in late August.

Historical Operations at Portsmouth

Environment, safety and health practices improved over the years as knowledge of hazards and controls were gained and new Federal regulations were put in place.

Effects of the presence of the transuranics and fission products from recycled reactor fuels, including plutonium, neptunium and technetium, with higher specific activities and exposure hazards than uranium is being evaluated to determine whether there were significant additional inhalation and ingestion hazards for workers in some locations. Radiological hazards in the Oxide Conversion Facility are also being evaluated.

We intend to conclude our work at Portsmouth this week and issue our final report by May of this year.

**Mass Flow Project**

The goal of this project is to reconstruct the historical generation and flow of recycled uranium, determine the transuranic and fission product contamination in the uranium, and where that contamination could have presented significant worker exposure or environmental hazards at our sites. This requires a relatively complete historical reconstruction of the flow of recycled uranium throughout the DOE complex.

To conduct this review, all sites where the recycled feed originated prior to shipment to GDPs for processing are reconstructing their shipments of recycled uranium, and the major receiver sites are reconstructing their receipts, shipments and process histories.

Approximately 131,000 metric tons of recycled uranium were shipped to the three GDPs. Paducah received most of this recycled uranium. In addition to the GDPs, substantial amounts of recycled uranium were also processed at Fernald and Y-12. Each of these sites is within the project scope and should complete a review of potential hazards associated with their recycling. We are tracking all recycled uranium shipments from the separations plants to the GDPs and other sites. After that, we will track those that we believe had significant contamination.[1]

[1] The benchmark we are using to gauge significant contamination in the recycled uranium is that the contamination contributes an incremental dose of ten percent or more over that of the uranium from the inhalation pathway. Within this ten percent, the uranium itself, not the fact that it was recycled, clearly dominates the hazard.

In general, the material shipped to Paducah and the other sites contained only trace amounts of transuranics, e.g., less then ten parts per billion of plutonium. However, our preliminary work revealed that some shipments from the separations plants may have been higher than this, and we are tracking these down. We are also concerned with processes on the sites that concentrated transuranics to a point where the radiological dose from them would be significant. Knowing these, and their history, would allow us to further pursue potential exposure of workers.

We will continue to champion this work in an effort to document the flow and quantities of recycled uranium transferred between sites across DOE. We hope to have final reports from our major originating and processing sites by June 2000.

**Exposure Assessment Project**

The goal of the Exposure Assessment project is to determine the scenarios under which GDP workers were exposed to radiation, those work activities that provided opportunities for radiation exposure, when workers were exposed to radiation, and what levels of worker radiation exposure were received from recycled uranium and its contaminants.

The Exposure Assessment team has received from the contractor a database of all available worker radiation exposure dosimetry information for both Paducah and Portsmouth, transcribed interviews that were conducted by the Oversight investigation team and created a library of critical documents. The team is progressing with their analysis with the goal of a preliminary report on Paducah with initial analysis of Portsmouth and ETTP/K-25 by April 30, 2000. A final report that updates Paducah and concludes the analyses of Portsmouth and ETTP/K-25 will be available by September 2000.

An important part of this preliminary work is to validate the data provided by the contractor. Also, since the urinalysis and whole body counting results provided were only in the form of raw data and were primarily for uranium, complex modeling is necessary to validate and calculate potential internal dose estimates that also take into consideration the transuranic (e.g. plutonium, neptunium) contribution. These internal worker doses will have to be added to worker external doses to estimate total radiation doses to workers. A more complete assessment of the exposure potential at Paducah will be available by the end of April.

**Medical Monitoring Program for Current and Former Workers**

In his August 1999 action plan, Secretary Richardson announced the medical monitoring programs at all three GDPs would be expanded and that they would include current workers. The program is conducted independently from the Department and is managed by a consortium including PACE, Queens College, University of Massachusetts at Lowell, and CPS. The screening program is focused mainly on detecting diseases of the lung, gastrointestinal system,

genitourinary system, and hearing loss. All participants receive a core medical exam including medical and exposure questionnaires; physical examination; spirometry; chest x-ray; audiometry; routine blood count and chemistries; and urinalysis.

Screening began in May 1999 at Paducah and Portsmouth, and in June 1999 at K-25. Through mid-February 2000, the project has screened 945 workers -- 355 at K-25, 270 at Portsmouth, and 320 at Paducah. Of those, 11% had emphysema, 27% had chronic bronchitis, and 12% had asbestos-related lung disease. I understand that Dr. Markowitz, who is overseeing the program, will testify today and can give you more detailed and up-to-date results.

**Compensation for Sick Workers**

The Clinton/Gore Administration's commitment to the veterans of the Cold War does not end with workers at Paducah. On July 15, 1999, prior to his announcement of actions to be taken at Paducah, Secretary Richardson, along with several Members of Congress, announced that the Clinton/Gore Administration would propose legislation to provide compensation – reimbursement of the cost of continuing medical care and a portion of prospective wages lost.

Because we established that Paducah workers had been exposed to radioactive materials without their full knowledge or without adequate protections, we also included a provision to provide certain workers with specified radiation-related cancers a $100,000 lump sum payment. This legislation was historic in that it was the first recognition by the federal government that employers of DOE contractors potentially made ill from exposures in the nuclear weapons complex should be recognized for their contributions to the nation's security and compensated for their illnesses. The Administration proposal was subsequently introduced as H.R. 3418 and S.1954.

At the same time, President Clinton directed the National Economic Council (NEC) to lead an interagency review to determine, by March 31, 2000, whether there are other illnesses that warrant inclusion in this program and how this should be accomplished. In support of that effort, the Administration has undertaken a number of activities to support the President's policy decision.

First, the NEC assembled an interagency panel of public and occupational health experts to assess available scientific evidence to determine if there are occupational illnesses among current, former and retired DOE contractor workers and evaluate the strength of that evidence. This assessment includes a review of existing: 1) epidemiological studies; 2) information on exposures to workplace hazards; 3) special medical monitoring programs for workers with the highest exposures to ionizing radiation; 4) medical screening programs for former DOE contractor workers exposed to radiation as well as physical and chemical hazards.

The second task undertaken by the NEC involves review of the state workers' compensation programs available to DOE contractor workers with occupational illnesses and a comparison the benefit levels of these programs, as well as those available to federal employees

under the Federal Employees' Compensation Act (FECA). Workers' compensation benefits for an injury or illness that a DOE contractor worker sustains on the job are currently paid through a state-run benefits program where the particular DOE facility is located. For the relatively small number of DOE federal employees, workers' compensation benefits are paid by the FECA program, managed by the U.S. Department of Labor, regardless of location of the facility where the injury or illness occurs.

Another important activity to supplement these more formal studies has been public meetings that we conducted at our major DOE sites to hear directly from current, former and retired workers what their experience has been. We have held meetings in: Paducah, KY; Piketon, OH; Oak Ridge, TN; Rocky Flats, CO; Hanford, WA; Nevada Test Site, NV; and Los Alamos, NM. Approximately 2,300 current, former and retired workers and/or their family members attended these meetings and more than 330 shared their stories.

Overall, we heard from DOE contractor employees who are proud of the work they have done to protect our national security. Most have no regrets about their work, but some feel betrayed that the government may have made them sick through needless exposures to the wide variety of hazards found at DOE facilities. Others feel sadness and disappointment that their supervisors, site managers and the government may have lied to them about the dangers of their work.

We saw many workers who are very ill, yet courageously gave testimonies on their work, health, and workers' compensation histories. Some workers with Chronic Beryllium Disease, asbestosis, and silicosis arrived at the meetings with oxygen tanks. Many, many workers reported diagnoses of cancers, including kidney, bone, lymphomas, multiple myelomas, leukemias, and breast cancer. The vast majority of workers told us that they would not file for workers' compensation; most stated that they were told 'not to bother to apply' because claims were routinely denied. The minority of workers who did apply rarely won their claims and many cases lasted for years. The few who were able to win their workers' compensation claims did not receive benefits adequate to their need for medical treatment and lost wages.

Based on input from two task forces and the data and personal information collected by DOE, the NEC will address the issues of whether additional occupational illnesses found in the DOE contractor workforce should be included in the compensation program outlined in the President's July 15, 1999, memorandum, and how this should be accomplished. As I noted earlier, the NEC review is to be completed by March 31, 2000.

Mr. Chairman, that concludes my testimony. I would be pleased to answer any questions from the Committee.